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XII. *Some experiments on the fungi which constitute the colouring matter of the red snow discovered in Baffin's Bay.* By FRANCIS BAUER, Esq. F. L. S. *In a Letter addressed to the Right Honourable Sir JOSEPH BANKS, Bart. G.C.B. P.R.S. &c. &c.*

Read May 11th, 1820.

SIR,

THE continuance of the severe cold weather, and the frequent falls of snow, during last winter, afforded me ample opportunity for investigating the nature and economy of the fungi, which constitute the colouring matter of the red snow, discovered in Baffin's Bay, on the 17th of August, 1818, during the Northern Expedition, under the command of Captain Ross ; and I have now the honor of laying before you, the result of my investigation ; and if you should consider it to merit the notice of the Royal Society, I should feel highly honoured by its being communicated to that learned Body, through your favor.

Since the month of March, 1819, I preserved in a small glass, a portion of the original sediment of the red snow, brought from Baffin's Bay, during which time the fungi, which constitute that sediment, had considerably increased in number ; but the newly formed fungi remained ever perfectly colourless, and formed a kind of whitish crust, at the top of the red sediment.

With a view to ascertain whether those fungi really vegetate, and propagate in the snow, after draining off the

water, I carefully separated the colourless crust, and taking out of the glass the greatest part of the red sediment (which I intended for another experiment, but which failed, and shall be described hereafter) I filled the glass again with water, and left it at rest for several hours; when the few fungi which were left in the glass, formed a slight sediment of about  $\frac{1}{40}$  part of an inch in thickness, at the surface of which the colourless crust, about  $\frac{3}{40}$  parts of an inch in thickness, remained. Fig. 1. in the annexed Plate (Pl. XVII.) is a correct representation of the glass, and the quantity and proportion of its contents.

On the 10th of December, 1819, when we had the first fall of snow, I marked with a diamond on the glass the precise height of the mass of sediment it contained, and after carefully draining off the water, I filled the glass with snow, which I pressed in as hard as I could, by which means the fungi became completely mixed and immersed in the snow. Thus prepared, I put the glass into a wire bird cage, to prevent its being disturbed by birds, or any thing else, and placed the cage in a N. W. aspect, in the open air. The weather was then very cold, and on the following morning, the 11th of December, the thermometer was 26 degrees below the freezing point. On the 13th of December the weather suddenly changed and became milder, and about noon the snow in the glass was entirely dissolved; on examination, after the glass had been fifty-two hours in the open air, I found the whole contents had formed a sediment, and had become of the same red colour as the original sediment was; but no increase in quantity was then perceptible; see Fig. 2.

I immediately poured off the water, and filled the glass again with snow, in the same manner as before, and exposed it in the open air, where it remained until the morning of the 17th of December, when a general thaw had begun; on examination I found the snow in the glass was not quite dissolved, but was a lump of ice, perforated, and full of cells, like a honeycomb, and the mass of fungi was raised in little pyramids; see Fig. 3.

From the 17th of December till the 28th, the weather continued very mild, and we had no snow till the morning of the 28th; on that day I filled the glass again with fresh snow; but perceiving a slight increase in a very small portion of fungi that were accidentally smeared on the corner of the mouth of the glass, when on the 13th of December I took out some of the sediment for examination, and sunk the small glass, with its contents, into a larger cylindrical glass, also filled and pressed with snow, to afford to that portion of fungi room for increasing and spreading in the snow; and in that state I exposed the whole in the open air.

From the 28th of December, 1819, to the 10th of January, 1820, the cold and frost continued very severe, but on the latter day, after the glass had been buried fourteen days under the snow, I took it out, to see what change might have taken place during that time; on clearing away the external snow and ice, I found the appearance of the contents of the small glass, exactly as represented in Fig. 4.

The snow was frozen to a hard mass of ice, which was beautifully perforated and full of small cells, and the whole mass of fungi was raised in a pyramidal form, almost to the

mouth of the glass, filling and occupying the perforations and cells in the ice; and from the base of the sediment, innumerable small air bubbles were visibly and rapidly evolving, by whose means, I think, the fungi are raised in the manner they are found during the time that the snow is dissolving. The small portion of fungi in the corner of the glass had also considerably increased, and spread in the snow above the small glass: see Fig. 4.

After making a drawing of the above described appearances, I deposited the small glass again into the larger one, which was filled with snow, as before, and exposed in the open air, where it remained till the 19th of January, 1820, when the weather changed, and a sudden and general thaw set in; after all the snow and ice were dissolved, and the glass stood several hours at rest, I had the satisfaction to find the appearance of the contents of the small glass, exactly as represented by Fig. 5.

If the sediment in the glass, represented in Fig. 5, is compared with that of Fig. 2, it is evident that, (though a considerable portion of the sediment had at several times been taken out of the glass for examination, and by the frequent changing of the water, some loss was sustained) the increase of fungi, within less than two months, has been more than double.

The only difference I observed, on examining the individual fungi of the newly formed sediment, was, that the number of larger than ordinary sized full grown fungi was greater in the newly formed sediment, than I ever found in the original sediment, brought from Baffin's Bay, where the ordinary size of the full grown red fungi is about a  $\frac{1}{1600}$  part of an

inch in diameter, and the largest are about  $\frac{1}{1200}$  part of an inch in diameter; the number of large fungi, in proportion to those of the ordinary size, is as 1 to 100; but in the newly formed sediment, after the above described experiments, I found many of the larger fungi to be as large as  $\frac{1}{800}$  part of an inch in diameter, and the number of large fungi, in proportion to those of the ordinary size, as 1 to 10.

I also found that, notwithstanding the snow in the glass had so frequently been changed, and though the fungi had sometimes been not more than three or four days in the snow, the water, after the snow was dissolved, always acquired the same disagreeable smell and taste as the original water imported from Baffin's Bay.

The above described experiments I attempted to repeat on a larger scale, and for that purpose I employed a glass of about twelve cubic inches in contents. The original red sediment which it contained was about  $\frac{1}{8}$  of an inch in thickness; and after marking on the glass with a diamond the precise height of the whole mass, I drained off the water, and divided the sediment in three equal parts; on the 12th of January, 1820, I put the different portions of sediment into three equally sized glasses, which I afterwards filled and pressed with snow, and exposed them in the open air, as in the former experiments.

The first few days, the weather continued very cold and favourable for the experiment, and the appearance in the glasses was the same as in the former experiment. The fungi in some glasses had risen and spread in rays and pyramids of near three inches in length, and the increase appeared considerable and rapid; but during the day of the

19th of January, the weather suddenly changed, and the snow in the glasses entirely dissolved; but the following night it froze again very hard, and two out of the three glasses burst and fell to pieces; the following morning, the 20th of January, it suddenly thawed again; and before I discovered the accident that had happened, a great part of the snow in the glasses was dissolved, and consequently the greatest part of the fungi they contained was lost; however, I collected all the sediment left in the unmelted snow and ice of the broken glasses, and put it into that which remained entire; after the whole was melted, the sediment which then was produced, certainly appeared considerably increased; but the original glass which had been marked with a diamond being destroyed, I could not form a correct estimate; judging however from the previous appearances, I have every reason to believe, that if the accident had not happened, the result of this experiment would have been equally satisfactory as that of the experiment on the small scale.

On the 22d of January I again filled the glass, containing the remains of the sediments of all the three glasses, with fresh snow, and exposed it in the open air as before; but the next day the general thaw began, and after that day we had no more frost nor snow; I left the glass in the open air till the end of the month, when I examined its contents again, and found no particular change in the substance; but within the glass, which was not quite full, round the surface of the water I observed a kind of crust, consisting of a light yellowish green substance, which on examination in the field of the microscope, proved to consist entirely of the same sized and shaped globules as the original red fungi. I imme-

diately decanted the water and red sediment into another glass ; when, on examining the empty glass, I found the appearance of the green substance was not only confined to the top of the glass, above the water mark, but I found many very minute clusters scattered, not only over the sides, but also over the bottom of the glass. I filled that glass with melted snow water, and closed it with a bladder, and in that manner I have kept it ever since.

I examined the glass this morning, and find that a considerable increase of the green fungi has taken place since the 31st of January, when I filled it with water ; the green substance forms now an entire crust over the whole inner surface of the glass, particularly the bottom, where the new globules now form a sediment that is visible to the naked eye, and the whole glass is now of a greenish tinge. To what cause this change of colour is to be attributed, I cannot guess.

The experiment mentioned in the beginning of my letter as having failed, was owing to an idea I conceived, that the red fungi would vegetate on the surface of the snow ; and with that view I filled on the 10th of December, 1819, a large glass cup with snow, pressing it hard, and giving it a perfectly smooth surface, on which I made an impression with a sixpenny piece ; the cavity thus produced I filled carefully with the original sediment of red fungi, expecting that on the slightest increase taking place, the fungi must come over the limits thus set them ; but the degree of cold at that time was so great, that, soaked in water as they then were, they froze almost before they came in contact with the snow. On examining them the next morning, when



the thermometer was 26 degrees below freezing, I found them of nearly a black colour, and almost entirely raised up, and detached from the snow; and when on the 13th of January the snow dissolved, the mass of fungi sunk to the bottom of the glass, and gradually changed their colour to a dirty brown, being evidently dead.

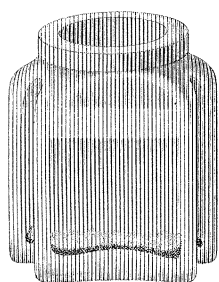
The same experiment was repeated several times, and the result was always the same. I subsequently collected the different masses of fungi that had been made use of in these experiments, and immersed them in snow, in one glass, and exposed them to the open air, as in former experiments; but though there was no visible change in the appearance whilst they were in the glass, I found, the latter end of January, when I examined them in the field of the microscope, that many new fungi had been produced during the time the dead sediment had been under the snow; and that the newly produced fungi were not only small and colourless, but had also many full grown bright red fungi amongst them. From this circumstance I conclude, that though the excessive cold, and the exposure in the sharp air and wind, may kill the primitive fungi, their seeds still retain sufficient vitality to vegetate and propagate, if immersed in the snow, which appears to me to be undoubtedly the natural soil of those fungi.

The season having passed by, I was unable to make any farther experiments on this subject.

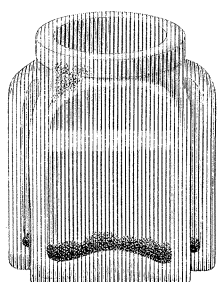
I have the honour to remain, &c. &c.

FRANCIS BAUER.

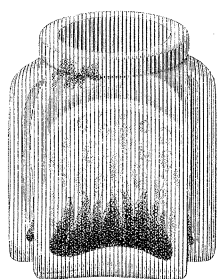
*Kew Green,  
May 7, 1820.*



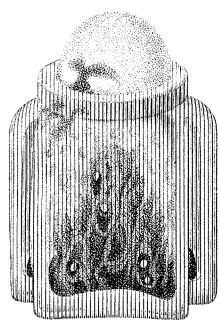
*Fig 1.*



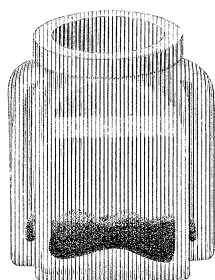
*Fig 2.*



*Fig 3.*



*Fig 4.*



*Fig 5.*

For the annexed meteorological diary, I am indebted to Mr. AITON. It is extracted from the diary kept in the Royal Botanic Garden, at Kew, and within 300 yards of the spot on which I made the experiments.

December, 1819.					January, 1820.						
		Degrees of Fahrenheit's Thermometer.			Wind and Weather.			Degrees of Fahrenheit's Thermometer.			Wind and Weather.
		M 8	A 2	E 8				M 8	A 2	E 8	
December	1	48	46	40	SW Rain.	January	1	10	26 $\frac{1}{2}$	35	SW Hazy.
	2	47	49	38	S Do.		2	19	24	35	SE Rain.
	3	26	42	37	SW Fine.		3	32	32	27	NW Snow.
	4	41	48	36	SW Rain.		4	20	28 $\frac{1}{2}$	19	W Cloudy.
	5	39	39	36	SW Cloudy.		5	17	28	20	S Hazy.
	6	38	36	36	NE Do.		6	22	37	33	S Cloudy.
	7	35	34	33	E Sleet.		7	33 $\frac{1}{2}$	32	26	E Do.
	8	31	30	32	E Cloudy.		8	25	30	26	NE Do.
	9	24	25	24	E Do.		9	22	28	29	NE Do.
	10	30	31	29	E Snow.		10	19	27	26	N Snow.
	11	6	24	20	W Fine.		11	27	28 $\frac{1}{2}$	33	SW Sleet.
	12	16	23	25	SW Do.		12	26 $\frac{1}{2}$	25	12	NE Cloudy.
	13	24	36	23	SW Do.		13	10	28	23	NE Do.
	14	19	35	31	SW Do.		14	24	27	24	NE Do.
	15	32 $\frac{1}{2}$	38	34	SW Rain.		15	2	21	25	SW Clear.
	16	32	39	30	SW Fine.		16	19	22	17	E Do.
	17	38	44	46	W Rain.		17	32	35	31	NE Hazy.
	18	52	54	50	W Cloudy.		18	27	31	33	NE Snow.
	19	51	55	54	SW Rain.		19	47	47	33	SW Rain.
	20	53	54	52	SW Cloudy.		20	29	33	32	NE Cloudy.
	21	54	54	53	W Do.		21	37	35	33	S Sleet.
	22	52	52	51	SW Do.		22	18	30	19	S Clear.
	23	49	41	39	W Do.		23	28	33	35	SW Cloudy.
	24	29 $\frac{1}{2}$	36	30	NW Do.		24	38	42	43	SW Do.
	25	31	33	28	E Do.		25	42	45	39	S Do.
	26	21	34	28	E Do.		26	45	48	45	S Rain.
	27	39	32	32	E Snow.		27	48	51	46	S Do.
	28	33 $\frac{1}{2}$	32	31	E Sleet.		28	42	48	38	NE Cloudy.
	29	24	28	23	NE Fine.		29	38	44	38	NE Do.
	30	14	31 $\frac{1}{2}$	31	NE Do.		30	40	48	45	SW Do.
	31	17	32 $\frac{1}{2}$	17	NE Do.		31	40	48	42	S Fine.